REMARKS

Claims 1-33 are pending. By this Amendment, claims 8, 9, 16, 22, 24, 29, 32 and 33 are canceled, claims 1, 3, 4, 10, 23, 25, 26, 30 and 31 are amended and new claims 34 and 35 are added.

Support for the amendments to the claims can be found throughout the application, including the drawings, as filed, for example at page 5, line 22 – page 6, line 17, and in FIG. 1. Therefore, no new matter has been added.

Claim Objections

Claims 24 was objected to under 37 C.F.R. § 1.75(c) for purportedly being of improper dependent form for failing to further limit the subject matter of a previous claim, claim 22 from which it depends. Applicants respectfully submit that the objection is now moot in view of the cancelation of claim 24.

Claim Rejections – 35 U.S.C. § 102

Claims 30, 31 and 33 stand rejected under 35 U.S.C. § 102 (b) as being anticipated by U.S. Patent No. 4,485,462 to Dakin ("Dakin"). Claim 33 has been canceled, and in so far as the rejections may apply to amended claims 30 and 31, the rejections are respectfully traversed.

Amended claim 30 now requires a monitoring apparatus that comprises a source for generating the sensing optical pulse signals; an interferometer stage for copying at least in part the optical pulse signals from the source such that for each optical pulse signal there is a pair of pulse signal copies, the interferometer stage having a delay stage to differentially delay one copy

of each pulse signal relative to the other copy; an output for launching the differentially delayed pulse signal copies onto the transmission link; and a processor circuit; wherein the interferometer stage is arranged to receive pulse signal copies returned by a process of distributed backscattering from the link and to combine the pulse signal copies so as to produce an interference signal, wherein at least one of said backscattered signal copies has suffered a phase change, and wherein the processor circuit is arranged to store the interference signal in association with an indication of a temporal characteristic of the return signal, wherein, when said phase change is caused by a time-varying disturbance, said interference signal stored in association with an indication of a temporal characteristic of the return signal enables the position of the disturbance to be determined from the time of return of phase-modulated backscattered components of said returned pulse signal copies, in combination with the other elements recited in the claim. Such a monitoring apparatus is not disclosed, or even suggested, by Dakin. Further, Dakin does not disclose or even mention backscattered signals and/or determining the position of a disturbance from the time of return of phase-modulated backscattered components of said returned pulse signal copies. Therefore, claim 30 is now allowable.

Amended claim 31 now recites, in combination with the other elements recited in the claim, that the position of the disturbance is determined from the time of return of phase-modulated backscattered components. As previously mentioned, Dakin does not disclose or even mention backscattered signals and/or determining the position of a disturbance from the time of return of phase-modulated backscattered components. Therefore, claim 31 is also now allowable.

Claim Rejections – 35 U.S.C. § 103

Claims 1, 2, 8-18, 22, 24-29 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,355,208 to Crawford et al. ("Crawford") in view of U.S. Patent Application Pub. No. 2003/0103211 to Lange et al. ("Lange"). Claims 3 and 4 stand rejected under § 103(a) as being unpatentable over Crawford, Lange and U.S. Patent No. 7,397,568 to Bryce et al. ("Bryce"). Claims 5-7 stand rejected under § 103(a) as being unpatentable over Crawford, Lange and further in view of U.S. Patent No. 7,110.677 to Reingang et al. ("Reingang"). Claims 19 and 21 stand rejected under § 103(a) as being unpatentable over Crawford, Lange and Dakin. Claim 20 stands rejected under § 103(a) as being unpatentable over Crawford, Lange, Dakin and U.S. Patent No. 4,855,915 to Dallaire et al. ("Dallaire"). Claim 23 stands rejected under § 103(a) as being unpatentable over Crawford, Lange and further in view of U.S. Patent No. 5,982,791 to Sorin et al. ("Sorin").

Claims 8, 9, 16, 22, 24, 29 and 32 have been canceled. In so far as the rejections may apply to the remaining amended claims, the rejections are respectfully traversed.

Amended claim 1 now recites, in combination with the other elements recited in the claim, "copying, at least in part, an output signal from an optical pulse source, such that there is a pair of signal copies by channeling light from the optical source onto first and second paths such that the power of the optical source traveling along each path is shared in a predetermined manner between the signal copies and one signal copy travels along the first path in an outbound direction with the other signal copy traveling along the second path in the outbound direction; delaying one of the pulse copies relative to the other pulse copy in the outbound direction;

combining light traveling in the outbound direction; and transmitting the combined light of the differentially delayed pair of signal copies onto the transmission link in the outbound direction."

According to amended claim 1, both signal copies of an output signal are combined and then transmitted onto the transmission link in the same "outbound" direction, and that the position of a disturbance is detected using the backscattered components of returned signal copies. The returned signal copies are split on their return, such as by the same coupler used to recombine the original outbound signal pairs. The split signals of the back-scattered components can then be also subjected to a differential delay in the return direction as they follow the same paths as the original outbound signals. The differentially delayed returned back-scattered signal components can then be recombined using the power-splitter that generated the original signal copies of a signal pulse, to generate a signal whose phase-modulation enables the position of the disturbance to be determined.

The method of amended claim 1 is not disclosed, suggested or evidenced in the references cited in the Office Action, alone or in combination. In particular, Crawford and Lange fail to disclose, suggest or include evidence of "transmitting the combined light of the differentially delayed pair of signal copies onto the transmission link in an outbound direction" as recited in amended claim 1.

Crawford teaches that with an extensive signal sensing loop there are no convenient and economical means for determining the location of an event (Crawford, col. 1, lines 48-54), that Sagnac sensors must operate in two modes either simultaneously or sequentially – one mode being with counter-propagating light signals such that a disturbance can generate a relative phase shift which depends on the location and severity of the disturbance (see id. at col.1, line 65 to

col. 2, line 5), the other mode using an optical frequency shifting element which produces a phase shift dependent on the severity of the disturbance (see id. at col. 2, lines 19-25) and that by processing both signals, the location can be determined (see id. at col. 2, lines 25-29).

FIG. 1 of Crawford is "a simplified version of the fiber optic sensing system . . . [and] only a single sensing loop 24 is shown." (Id. at col. 4, lines 25-29.) In Crawford, a light source splits a beam of light into two beams which travel around the common path of the sensing loop in opposite directions and are recombined to produce an interference pattern (Id. at col. 4, lines 29-42.) However, the light source 21, splitter, 23, sensing fiber loop 24, and detector 30 operate in combination as a Sagnac interferometer in which the output beam from light source 21 is split into two beams by splitter 23, which beams *propagate in opposite directions through the common path of the sensing fibre 24*. (Id. at col. 5, lines 14-19; emphasis added.)

Figure 2 of Crawford shows "the *additional elements* required to provide means for location of the point of contact or intrusion on the sensing fiber loop. These elements are not shown in FIG. 1 . . . [and] as depicted in FIG. 2, *two* overlapping sensing fiber loops [each] operating as Sagnac interferometers are employed." (Id. at col. 7, lines 55-63; emphasis added.) Col. 8, lines 58-64, of Crawford clearly indicate that the difference in the time of arrival of the leading edge of a common disturbance at detectors 30a (for the sensing fiber loop 24a) and 30b (for the sensing fiber loop 24b) is measured and analyzed to compute the location of the point of disturbance X.

Accordingly, at no point does Crawford disclose or suggest determining the location of a disturbance using just one fiber loop, or transmission link. In Crawford, two loops, optical sources and detectors are used, and the loops must be deployed contiguously so that they

provided a "common sensing fiber loop." This is in contrast with amended claim 1, which requires "transmitting the combined light of the differentially delayed pair of signal copies onto the transmission link in the outbound direction." Thus, claim 1 requires only one transmission link, such that only one signal source is required to detect the location of a disturbance, and one detector, etc., a far simpler arrangement to deploy and maintain. A person of ordinary skill in the art who reads Crawford accordingly would not be taught that if backscattered signals are used the location of a disturbance can be detected using just one optical fibre loop.

Even if combined as suggested in the Office Action, Lange fails to remedy the deficiencies of Crawford. Further, the Office Action cites Lange as disclosing that the components are backscattered components, after conceding that Crawford does not disclose such a feature. Lange, however, describes splitting a signal into two copies, phase modulating both signal copies (using phase modulators 118, 116), combing the modulated phase copies using a coupler 120, optionally further delaying the combined modulated signal using a delay loop (124) before sending the combined modulated signal into a device or optical fiber to be tested (150). (See Lange at para. [0043] et seq.) In Lange, phase modulation is applied to the sensing signals at a known location. Lange does not disclose or suggest using backscattered signal components whose phase-modulation is induced by the disturbance, and using this to detect the location of the disturbance which has caused the phase modulation in the manner of the invention presented in the amended claims. Refer, for example, to paragraph [0044] of Lange in contrast with amended claim 1, which recites "receiving in a return direction from the transmission link return signals comprising backscattered components comprising at least partially returned copies of said signal copies previously transmitted on said transmission link, wherein at least one of said

backscattered components has suffered a phase change caused by said time-varying disturbance," and "wherein the position of the disturbance is determined from the time of return of said phase-modulated backscattered components of said returned signal copies." In view of the concession on page 7 of the Office Action, this is also neither disclosed nor suggested by Crawford, nor by the remaining references cited in the Office Action though not with respect to claim 1.

Therefore, claim 1 is allowable over the cited references, whether alone or when combined as suggested in the Office Action. Claims 2-7, 10-15 and 17-21 depend from claim 1 and are therefore allowable at least for this reason, the rejections of claims 2-7, 10-15 and 17-21 being traversed but not expressly argued herein in view of the allowability of the underlying base claim.

Amended claim 26 recites "an interferometer stage for copying at least in part the optical pulse signals from the source such that for each optical pulse signal there is a pair of pulse signal copies, the interferometer stage having a delay stage to differentially delay one copy of each pulse signal relative to the other copy; an output for launching the differentially delayed pulse signal copies onto the transmission link," and that "when said phase change is caused by a time-varying disturbance, said interference signal stored in association with an indication of a temporal characteristic of the return signal enables the position of the disturbance to be determined from the time of return of the phase-modulated backscattered components of said returned pulse signal copies." Therefore, at least for reasons similar to those set forth above with respect to claim 1 and the deficiencies of Crawford and Lange, claim 26 is also now allowable. Applicant also submits that the deficiencies of Crawford and Lange with respect to claim 26 are not remedied by Bryce, apparently also cited with respect to claim 26 (see page 15 of the Office

Action), or any of the other references cited in the Office Action though not explicitly applied to claim 1 or claim 26. Claim 27 and 28 depend from claim 26 and are therefore also now allowable, the rejections of these claims being traversed but not expressly argued in view of the allowability of the underlying base claim.

Accordingly it is submitted that an unimaginative person skilled in the art who reads Crawford in combination with Lange would not find the invention as set out in the amended independent claims obvious.

New Claims

New claims 34 and 35 are added, and claims 25 and 23 have been amended to depend therefrom, respectively. At least for reasons set forth herein above with respect to amended claims 1, 26, 30 and/or 31, new claims 34 and 35 are also in condition for allowance.

Conclusion

In view of the foregoing, it is submitted that this application is in condition for allowance. Favorable consideration and prompt allowance of the application are respectfully requested.

The Examiner is invited to telephone the undersigned if the Examiner believes it would be useful to advance prosecution.

Respectfully submitted,

Amy M. Salmela
Registration No. 55910

Customer No. 24113
Patterson Thuente Christensen Pedersen, P.A.
4800 IDS Center
80 South 8th Street
Minneapolis, Minnesota 55402-2100
Telephone: 612.252.1538